

WHAT IS CLAIMED IS:

1. A communication system in which, when a communication terminal device transmits data to a mobile terminal through a plurality of base stations, each of a plurality of switching devices included in communication paths between the communication terminal device and the plurality of base stations transmits packet data in a multicast manner to a plurality of devices connected to the switching device, comprising:

a first determiner which, based on a time period necessary for transmission of the packet data from each of one or more of the plurality of switching devices to one or more base stations connected to the switching device and based on a time period necessary for transmission of the packet data from each of one or more of the plurality of switching devices to one or more switching devices connected to the switching device at mobile terminal side, determines, for each of the switching devices, transmission timing indicating timing at which the switching device transmits the packet data to the plurality of devices connected to the switching device so that data reception timings at the mobile terminal become simultaneous among the plurality of base stations; and

a first transmitter which, in each of the switching devices, transmits the packet data to the plurality of devices connected to the switching device, based on the transmission timing determined by the first determiner.

2. A communication system according to claim 1, further comprising:

a first generator which generates a plurality of radio slot data, based on transmission target packet data that is packet data transmitted to a first switching device that is the closest switching device to the communication terminal device among the plurality of switching devices in the communication paths, and based on the number of devices that are destinations of multicast transmission by the first switching device;

a second generator which generates packet data containing radio slot data generated by the first generator;

a second transmitter which, in the first switching device, transmits each of the packet data generated by the second generator to a plurality of devices connected to the first switching device, based on transmission timing determined by the first determiner and associated with the first switching device;

a third generator which generates a plurality of packet data containing radio slot data, based on each of the packet data transmitted to a second switching device that is each of one or more switching devices other than the first switching device among the plurality of switching devices, and based on the number of devices that are destinations of multicast transmission by the second switching device; and

a third transmitter which, in the second switching device, transmits each of the packet data generated by the third generator to a plurality of devices connected to the second switching device, based on transmission timing determined by the first determiner and associated with the second switching device,

wherein, when each of the plurality of base stations transmits radio slot data contained in each of the packet data

to the mobile terminal, the mobile terminal generates the transmission target packet data, based on the radio slot data transmitted from each of the plurality of base stations.

3. A communication system according to claim 1, further comprising:

a second determiner which, based on each transmission timing determined by the first determiner, determines reception timing indicating timing at which each of the plurality of base stations receives the packet data, and reception timing indicating timing at which each of one or more of second switching devices that are other switching devices than a first switching device that is the closest switching device to the communication terminal device among the plurality of switching devices in the communication paths receives the packet data so that data reception timings at the mobile terminal become simultaneous among the plurality of base stations;

a difference information generator which, if there is a difference between at least one timing, among timing at which each of the plurality of base stations received the packet data and timing at which each of the one or more of the second switching devices received the packet data, and the reception timing determined by the second determiner corresponding to the one timing, generates difference information indicating the difference; and

a second transmitter which, in a predetermined switching device, on acquisition of the difference information from a predetermined device, transmits packet data to the predetermined device at predetermined transmission timing for the predetermined device to receive the packet data at reception

timing which is determined by the second determiner.

4. A communication system according to claim 3, further comprising:

a third transmitter which, if the second transmitter cannot transmit the packet data to the predetermined device at the predetermined transmission timing, transmits transmission impossibility information to this effect to a terminal side switching device that is a switching device connected to the predetermined switching device at the communication terminal device side; and

a fourth transmitter which, in the terminal side switching device, transmits packet data to the predetermined switching device at transmission timing for the second transmitter to transmit packet data to the predetermined device at the predetermined transmission timing, based on the transmission impossibility information.

5. A communication system in which, when a mobile terminal transmits packet data to a communication terminal device through each of a plurality of base stations, a plurality of switching devices included in communication paths between the communication terminal device and the plurality of base stations receives packet data from a plurality of devices connected to the switching device, comprising:

a radio slot generator which, in the mobile terminal, generates radio slot data while associating each radio slot data with transmission sequence information indicating transmission sequence, based on transmission target packet data that is packet data to be transmitted to the communication

terminal device, and based on the number of base stations;

a packet generator which, in each of the base stations, on acquisition of the radio slot data, generates, for each of the radio slot data, packet data containing the radio slot data and reliability information indicating reception quality of the radio slot data;

a first transmitter which, in each of the base stations, transmits a plurality of the packet data generated by the packet generator to a switching device connected to the base stations;

a first selector which, when a plurality of pieces of the packet data are transmitted to a second switching device from a plurality of devices connected to the second switching device that is each of one or more switching devices other than a first switching device that is the closest switching device to the communication terminal device among the plurality of switching devices in the communication paths, selects given radio slot data from among a plurality of pieces of radio slot data contained in the plurality of pieces of packet data, based on the transmission sequence information and the reliability information associated with each of the plurality of pieces of packet data;

a second transmitter which transmits each packet data containing the radio slot data selected by the first selector to a switching device connected to the second switching device;

a second selector which, when a plurality of pieces of packet data are transmitted to the first switching device from a plurality of devices connected to the first switching device, selects given plurality of pieces of radio slot data from among a plurality of pieces of radio slot data contained in the plurality of pieces of packet data, based on the transmission

sequence information and the reliability information associated with each of the plurality of pieces of packet data;

a transmission target packet generator which generates the transmission target packet data, based on the plurality of pieces of radio slot data selected by the second selector; and

a third transmitter which transmits the transmission target packet data to the communication terminal device.

6. A communication system according to claim 5, further comprising:

a repeat request transmitter which, if the second selector selects given plurality of pieces of radio slot data from among a plurality of pieces of radio slot data contained in the plurality of pieces of pack, but cannot select radio slot data associated with given transmission sequence information, transmits a request for the radio slot data associated with the predetermined transmission sequence information to the mobile terminal,

wherein upon acquisition of the radio slot data associated with the given transmission sequence information from the mobile terminal, the transmission target packet generator generates the transmission target packet data, based on the acquired radio slot data and the given plurality of pieces of radio slot data selected by the second selector.

7. A multicast switching device which transmits packet data to a plurality of devices in a multicast manner when a communication terminal device transmits data to a mobile terminal through a plurality of base stations, comprising:

a first determiner which, based on a time period necessary

for transmission of the packet data ,from each of one or more of the plurality of switching devices that is included in communication paths between the communication terminal device and the plurality of base stations and executes multicast transmission of the packet data, to one or more base stations connected to the switching device and based on a time period necessary for transmission of the packet data from each of one or more of the plurality of switching devices to one or more switching devices connected to the switching device at mobile terminal side, determines, for each switching device, transmission timing indicating timing at which each switching device transmits the packet data to a plurality of devices connected to the switching device so that data reception timings at the mobile terminal become simultaneous among the plurality of base stations;

a first transmitter which transmits each of the transmission timings determined by the first determiner to the switching device corresponding to the transmission timing; and

a second transmitter which transmits the packet data to a plurality of devices that are destinations of multicast transmission, based on the transmission timing that is determined by the first determiner and associated with the multicast switching device.

8. A multicast switching device which transmits packet data to a plurality of devices in a multicast manner when a communication terminal device transmits data to a mobile terminal through a plurality of base stations and which is a switching device closest to the communication terminal device among a plurality of switching devices that are included in

communication paths between the mobile terminal and the communication terminal device and execute the multicast transmission, comprising:

a first determiner which, based on a time period necessary for transmission of the packet data to the plurality of base stations from each of one or more of the plurality of switching devices that is included in communication paths between the communication terminal device and the plurality of base stations and executes multicast transmission of the packet data, and based on a time period necessary for transmission of the packet data from each of one or more of the plurality of switching devices to one or more switching devices connected to the switching device at mobile terminal side, determines, for each switching device, transmission timing at which each switching device transmits the packet data to a plurality of devices connected to the switching device so that data reception timings at the mobile terminal become simultaneous among the plurality of base stations;

a first transmitter which transmits each of the transmission timings determined by the first determiner to the switching device corresponding to the transmission timing;

a first generator which generates a plurality of radio slot data, based on transmission target packet data that is packet data transmitted from the communication terminal device, and based on the number of devices that are destinations of multicast transmission of the packet data;

a second generator which generates packet data containing radio slot data generated by the first generator; and

a second transmitter which transmits each of the packet data generated by the second generator to a plurality of devices



that are destinations of multicast transmission, based on the transmission timing that is determined by the first determiner and associated with the multicast switching device.

9. A multicast switching device according to claim 8, further comprising:

a second determiner which, based on each transmission timing determined by the first determiner, determines reception timing indicating timing at which each of the plurality of base stations receives the packet data and reception timing indicating timing at which each of one or more of low-order multicast transmission devices that are other switching devices than the switching device closest to the communication terminal device among the plurality of switching devices in the communication paths receives the packet data, so that data reception timings at the mobile terminal become simultaneous among the plurality of base stations;

an acquisition unit configured to acquire transmission impossibility information indicating that a predetermined low-order multicast switching device cannot transmit packet data to a predetermined device at predetermined transmission timing for the predetermined device to receive the packet data at the reception timing which is determined by the second determiner, if there is a difference between at least one timing, among timing at which each of the plurality of base stations received the packet data and timing at which each of one or more of low-order multicast switching devices received the packet data, and the reception timing determined by the second determiner, corresponding to the one timing, and when the predetermined low-order multicast switching device acquires

difference information from the predetermined device after the difference information indicating the difference is generated; and

a third transmitter which, based on the transmission impossibility information, transmits packet data to the predetermined low-order multicast switching device at transmission timing for the predetermined low-order multicast switching device to transmit the packet data to the predetermined device at the predetermined transmission timing.

10. A multicast switching device which transmits packet data to a plurality of devices in a multicast manner when a communication terminal device transmits data to a mobile terminal through a plurality of base stations and which is a switching device other than a switching device closest to the communication terminal device among a plurality of switching devices that are included in communication paths between the mobile terminal and the communication terminal device and execute the multicast transmission, comprising:

a first acquisition unit configured to acquire transmission timing of the packet data from a device which determines, for each of the plurality of switching devices, transmission timing at which each of the switching devices transmits the packet data to a plurality of devices connected to the switching device so that data reception timings at the mobile terminal become simultaneous among the plurality of base stations;

a second acquisition unit configured to acquire generated packet data when the switching device closest to the communication terminal device generates, based on transmission

target packet data which is packet data transmitted from the communication terminal device and based on the number of devices which are destinations of multicast transmission by the switching device closest to the communication terminal device, a plurality of radio slot data and packet data containing the generated radio slot data;

a generator which generates a plurality of packet data containing radio slot data, based on the packet data acquired by the second acquisition unit and based on the number of devices that are destinations of multicast transmission; and

a first transmitter which transmits each of the packet data generated by the generator to a plurality of devices that are destinations of multicast transmission, based on the transmission timing acquired by the first acquisition unit.

11. A multicast switching device according to claim 10, further comprising:

a third acquisition unit configured to acquire reception timing associated with the multicast switching device when the reception timing is determined so that data reception timings at the mobile terminal become simultaneous among the plurality of base stations, the reception timing indicating timing at which each of one or more of the low-order multicast switching devices, other than the switching device closest to the communication terminal device among the plurality of switching devices in the communication paths, receives the packet data;

a difference information generator which, if there is a difference between timing at which the packet data was received and the reception timing acquired by the third acquisition unit, generates difference information indicating the difference;

a second transmitter which transmits the difference information to a switching device executing multicast transmission that is connected to the multicast switching device at communication terminal device side;

a fourth acquisition unit configured to acquire, when a predetermined device acquires reception timing after the reception timing indicating timing at which the predetermined device receives the packet data is determined so that data reception timings at the mobile terminal become simultaneous among the plurality of base stations, difference information indicating a difference between timing at which the predetermined device received the packet data and the reception timing;

a third transmitter which, based on the difference information acquired by the fourth acquisition unit, transmits the packet data to the predetermined device at predetermined transmission timing for the predetermined device to receive the packet data at the reception timing; and

a fourth transmitter which, if the third transmitter cannot transmit the packet data to the predetermined device at the predetermined transmission timing, transmits transmission impossibility information to the switching device executing multicast transmission that is connected to the multicast switching device at the communication terminal device side.

12. A multicast switching device which acquires packet data from a plurality of devices when a mobile terminal transmits packet data to a communication terminal device through a plurality of base stations and which is a switching device other than a switching device closest to the communication terminal

device among a plurality of switching devices that are included in communication paths between the mobile terminal and the communication terminal device and acquire packet data from a plurality of devices, comprising:

an acquisition unit configured to acquire generated packet data from the plurality of devices when the mobile terminal generates, based on transmission target packet data which is packet data to be transmitted to the communication terminal device and based on the number of base stations, radio slot data while associating each radio slot data with transmission sequence information indicating transmission sequence, and then each base station acquires the radio slot data and generates, for each of the radio slot data, packet data containing the radio slot data and reliability information indicating reception quality of the radio slot data;

a selector which selects given radio slot data from among plurality of pieces of radio slot data contained in the plurality of pieces of packet data, based on transmission sequence information and reliability information associated with each of the plurality of pieces of packet data; and

a transmitter which transmits each packet data containing the radio slot data selected by the selector to the switching device that is connected to the multicast switching device at communication terminal device side and acquires packet data from a plurality of devices.

13. A multicast switching device which acquires packet data from a plurality of devices when a mobile terminal transmits packet data to a communication terminal device through a plurality of base stations and which is a switching device

closest to the communication terminal device among a plurality of switching devices that are included in communication paths between the mobile terminal and the communication terminal device and acquire packet data from a plurality of devices, comprising:

an acquisition unit configured to acquire generated packet data from the plurality of devices when the mobile terminal generates, based on transmission target packet data which is packet data to be transmitted to the communication terminal device and based on the number of base stations, radio slot data while associating each radio slot data with transmission sequence information indicating transmission sequence, and then each base station acquires the radio slot data and generates, for each of the radio slot data, packet data containing the radio slot data and reliability information indicating reception quality of the radio slot data;

a selector which selects given plurality of pieces of radio slot data from among plurality of pieces of radio slot data contained in the plurality of pieces of packet data, based on transmission sequence information and reliability information associated with each of the plurality of pieces of packet data;

a generator which generates the transmission target packet data, based on the plurality of pieces of radio slot data selected by the selector; and

a transmitter which transmits the transmission target packet data to the communication terminal device.

14. A communication method in which, when a communication terminal device transmits data to a mobile terminal through a

plurality of base stations, each of a plurality of switching devices included in communication paths between the communication terminal device and the plurality of base stations transmits packet data in a multicast manner to a plurality of devices connected to the switching device, comprising:

determining, for each switching device, transmission timing indicating timing at which the switching device transmits the packet data to a plurality of devices connected to the switching device, based on a time period necessary for transmission of the packet data from each of one or more of the plurality of switching devices to one or more base stations connected to the switching device and based on a time period necessary for transmission of the packet data from each of one or more of the plurality of switching devices to one or more switching devices connected to the switching device at mobile terminal side, so that data reception timings at the mobile terminal become simultaneous among the plurality of base stations; and

in each of the switching devices, transmitting the packet data to the plurality of devices connected to the switching device, based on the transmission timing determined by the determining step.

15. A communication method in which, when a mobile terminal transmits packet data to a communication terminal device through each of a plurality of base stations, a plurality of switching devices included in communication paths between the communication terminal device and the plurality of base stations receives packet data from a plurality of devices

connected to the switching device, comprising:

in the mobile terminal, generating (first generating step) radio slot data while associating each radio slot data with transmission sequence information indicating transmission sequence, based on transmission target packet data which is packet data to be transmitted to the communication terminal device, and based on the number of base stations;

in each of the base stations, on acquisition of the radio slot data, generating (second generating step), for each of the radio slot data, packet data containing the radio slot data and reliability information indicating reception quality of the radio slot data;

in each of the base stations, transmitting a plurality of the packet data generated by the second generating step to a switching device connected to the base station;

selecting (first selecting step), based on transmission sequence information and reliability information associated with each of plurality of pieces of the transmitted packet data, given radio slot data from among a plurality of pieces of radio slot data contained in the plurality of pieces of packet data when a plurality of pieces of the packet data are transmitted to a second switching device from a plurality of devices connected to the second switching device, the second device being each of one or more switching devices other than a first switching device which is a switching device closest to the communication terminal device among the plurality of switching devices in the communication paths;

transmitting each packet data containing the radio slot data selected by the first selecting step to a switching device connected to the second switching device;



selecting (second selecting step), when a plurality of pieces of packet data are transmitted to the first switching device from a plurality of devices connected to the first switching device, given plurality of pieces of radio slot data from among a plurality of pieces of radio slot data contained in the plurality of pieces of packet data, based on the transmission sequence information and the reliability information associated with each of the plurality of pieces of packet data;

generating the transmission target packet data based on the plurality of pieces of radio slot data selected by the second selecting step; and

transmitting the transmission target packet data to the communication terminal device.